

**DATA QUALITY SUMMARY REPORT
FOR PM_{2.5} SULFATE DATA COLLECTED BY
SONOMA TECHNOLOGY, INC., DURING THE
CALIFORNIA REGIONAL PM₁₀/PM_{2.5}
AIR QUALITY STUDY**

By:

**Nicole P. Hyslop
Steven G. Brown
Courtney A. Gorin
Hilary R. Hafner
Sonoma Technology, Inc.
1360 Redwood Way, Suite C
Petaluma, CA 94954-1169**

Prepared for:

**San Joaquin Valleywide Air Pollution Study Agency
c/o Karen Magliano
California Air Resources Board
1001 "I" Street
Sacramento, CA 95814**

February 20, 2003

This page is intentionally blank.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1. INTRODUCTION AND OBJECTIVES	Q-1
2. DATA COMPLETENESS	Q-1
3. LOWER QUANTIFIABLE LIMIT	Q-2
4. ACCURACY	Q-3
5. PRECISION	Q-3
6. REFERENCES	Q-4

LIST OF TABLES

<u>Table</u>	<u>Page</u>
Q-1. Location and duration of sulfate measurements performed by STI during CRPAQS....	Q-1
Q-2. Data quality objectives for sulfate data collected during CRPAQS	Q-1
Q-3. Data completeness values for sulfate at each site	Q-2
Q-4. Time period used to calculate LQL, the LQL, and the corresponding mean concentration during the selected time period	Q-3
Q-5. Precision, the number of data points, time period, and mean of the data used to calculate the precision of the SO ₄ data at Bakersfield	Q-3

This page is intentionally blank.

1. INTRODUCTION AND OBJECTIVES

The purpose of this Data Quality Summary Report is to provide data users with an understanding of the quality of PM_{2.5} sulfate (SO₄) data collected by Sonoma Technology, Inc. (STI) for the California Regional PM₁₀/PM_{2.5} Air Quality Study (CRPAQS). **Table Q-1** summarizes the operating sites and times for sulfate concentration measurements during CRPAQS. This report provides summary information on data completeness, lower quantifiable limit (LQL), accuracy, and precision. The sulfate instrument measured PM_{2.5} sulfate concentrations (µg/m³) on a 10-minute basis. The 10-minute data were also averaged to 60-minute concentrations; both data sets were reported in the corresponding database and reports. Data completeness was calculated for all sites based on data delivered to ARB; the start date/time indicates the beginning of valid data, continuous until the stop date/time. Note that this instrument operated for only one month. A sulfate instrument was deployed at Angiola; however, numerous instrument problems resulted in no valid data reported for this site.

Table Q-1. Location and duration of sulfate measurements performed by STI during CRPAQS.

Site	Start Date/Time	Stop Date/Time
Bakersfield	1/13/01 12:50 PST	2/16/01 8:50 PST

Several other documents are available from which to obtain information about the CRPAQS field study and data processing. Sampling locations are described in Wittig et al. (2003). Quality control screening procedures are summarized by Hafner et al. (2003). Results of systems and performance audits and intercomparisons are provided by Bush et al. (2001).

The data quality objectives (DQOs) for sulfate from instrument specifications are shown in **Table Q-2**. DQOs were not available for data completeness, accuracy, or precision. The LQL for sulfate met the DQO.

Table Q-2. Data quality objectives for sulfate data collected during CRPAQS.

Data Quality Metric	Objective
Lower Quantifiable Limit	1 µg/m ³

2. DATA COMPLETENESS

Data completeness for sulfate is shown in **Table Q-3**. Data capture quantifies the percentage of total records received versus the number expected during the “period of operation” defined by the start and stop dates/times in Table Q-1; the start date/time is the first instance of valid data, and the period of operation is continuous until the stop date/time. The number of valid data points is divided by the number of captured data points to calculate the data recovery.

Validity is defined for this calculation as any data point that has a quality control flag of V0 (valid) or V1 (valid but comprised wholly or partially of below-MDL data). Details of data validation are included in Hafner et al. (2003).

Table Q-3. Data completeness values for sulfate at each site.

Monitoring Site	Total No. of Records	No. of Expected Records	Percent Capture ^a	No. of Valid Records	Percent Recovery ^b	No. of Suspect Records	No. of Invalid Records	No. of Missing Records
Bakersfield (10-min)	4873	4873	100%	3891	80%	377	8	597
Bakersfield (60-min)	813	813	100%	580	71%	64	81	88

^a % of capture = total number of records/expected records*100%

^b % recovery = number of valid records/total number of records

Sulfate data had a 100% data capture rate. Data recovery rates ranged from 71% (60-minute) to 80% (5-minute).

3. LOWER QUANTIFIABLE LIMIT

The LQL is the lowest concentration in ambient air that can be measured when processing actual samples. Sources of variability that influence the monitored signal at low concentrations include instrument noise and atmospheric variability. As a measure of this variability, two times the standard deviation of selected 10-minute and 60-minute data was used to estimate the LQL for the 5-minute and 60-minute data, respectively. The selected data were collected during relatively stable periods with concentrations close to zero. This is a conservative estimate of the LQL because it includes the concentration variability of the ambient air. Six consecutive data values were used to compute the LQL for both the 10-minute and 60-minute data; atmospheric variation generally becomes too great after six hours to calculate a reasonable LQL.

The LQL is calculated as shown in Equation Q-1. **Table Q-4** shows the 10-minute and 60-minute LQL, as well as the specific data strings used to calculate the LQL. The LQLs for both 10-minute and 60-minute data meet the DQO.

$$LQL \approx 2s = 2\sqrt{\frac{\sum (SO_4 - \overline{SO_4})^2}{N - 1}} \quad (Q-1)$$

where

$\overline{SO_4}$ = mean SO_4 concentration
N = number of measurements
 σ = standard deviation

Table Q-4. Time period used to calculate LQL, the LQL, and the corresponding mean concentration during the selected time period.

Type of data	Time Period Used in LQL Calculation	LQL ($\mu\text{g}/\text{m}^3$)	Mean ($\mu\text{g}/\text{m}^3$)
10-minute	2/11/01 20:50 – 21:50 PST	0.08	0.02
60-minute	2/11/01 18:00 – 2/12/01 00:00 PST	0.07	0.06

4. ACCURACY

Calibration data for the sulfate instruments are not available because this instrument cannot be calibrated in a manner similar to instruments measuring gaseous species. Therefore accuracy calculations are beyond the scope of this report for this instrument.

5. PRECISION

Precision can be estimated for the sulfate instrument by evaluating the variance of sulfate concentrations during a period of low variability, when atmospheric influence on variability is assumed to be minimal. 10-minute and 60-minute data collected during periods of low variability, but when concentrations were well above the LQL, were selected. The precision was then evaluated by calculating the coefficient of variation (CV) during the period of low variability, as shown in Equation Q-3.

$$\text{Precision} \approx \text{CV} = \frac{\sigma_{\text{measured}}}{[\overline{\text{SO}_4}]_{\text{measured}}} \times 100\% \quad (\text{Q-3})$$

where:

$$\sigma_{\text{measured}} = \sqrt{\frac{\sum ([\text{SO}_4]_{\text{measured}} - [\overline{\text{SO}_4}]_{\text{measured}})^2}{N - 1}}$$

All the sulfate concentrations in Equation 5-1 refer to the concentrations measured during the selected time period. **Table Q-5** shows the precision calculated for Bakersfield.

Table 5-1. Precision, the number of data points, time period, and mean of the data used to calculate the precision of the SO_4 data at Bakersfield.

Interval	No. of Data Points Used	Time Period	Mean ($\mu\text{g}/\text{m}^3$)	Precision
10-minute	6	2/6/01 09:40 – 10:40 PST	3.52	7.9 %
60-minute	11	1/22/01 14:00 – 1/23/01 01:00 PST	2.94	8.0 %

6. REFERENCES

- Bush D., Baxter R., and Yoho D. (2002) Final quality assurance audit report - California Regional PM_{2.5}/PM₁₀ Air Quality Study (CRPAQS). Prepared for San Joaquin Valleywide Air Pollution Study Agency c/o California Air Resources Board, Sacramento, CA, by Parsons Engineering Science, Inc., Pasadena, CA, June.
- Hafner H.R., Hyslop N.P., and Green C.N. (2003) California Regional PM₁₀/PM_{2.5} Air Quality Study management of anchor site data. Prepared for the San Joaquin Valleywide Air Pollution Study Agency c/o California Air Resources Board, Sacramento, CA, by Sonoma Technology, Inc., Petaluma, CA, 999242-2087-FR (scheduled for publication May 2003).
- Watson J.G., DuBois D.W., DeMandel R., Kaduwela A., Magliano K., McDade C., Mueller P.K., Ranzieri A., Roth P.M., and Tanrikulu S. (1998) Aerometric monitoring program plan for the California Regional PM_{2.5}/PM₁₀ Air Quality Study. Draft report prepared for the California Regional PM₁₀/PM_{2.5} Air Quality Study Technical Committee, California Air Resources Board, Sacramento, CA, by Desert Research Institute, Reno, NV, DRI Document No. 9801.1D5, December.
- Wittig A.E., Blumenthal D.L., Roberts P.T., and Hyslop N.P. (2003) California Regional PM₁₀/PM_{2.5} Air Quality Study anchor site measurements and operations. Final report prepared for the San Joaquin Valleywide Air Pollution Study Agency c/o California Air Resources Board, Sacramento, CA, Sonoma Technology, Inc., Petaluma, CA, STI-999231-2332-FR (scheduled for publication May 2003).